

The increase in missing waveform images of the F-net broadband seismograph network preceding the 2011 Tohoku earthquake

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1. Introduction

The F-net is a broadband seismograph network constituted of 73 STS-1 and 2 seismometers. Natural frequency of the seismometers is 120 seconds (STS-2) and longer, thus they can detect long-period ground motion.

On its website, waveform images are provided. The analyses on them so far have shown the following. The Daily Spectral Plot, even on a quiet day, shows existence of vibration with frequency in 2-5 seconds. On days of large fluctuation, the amplitude increases, and the vibrations of 5 seconds and longer are added. The Daily Plot shows fluctuations with the period of several days to 2 weeks, and the Hourly Plot shows those for several hours to several days (Sue, 2010).

2. Analysis

Since seismometers detect ground vibrations, meanwhile their operations might be affected. Thus operational status is investigated. There are two sources on it.

a. Data acquisition trouble log: It is the formal information covering from instantaneous to long-lasting loss of data. Reasons for troubles are shown. While, update of the information is irregular.

b. Missing of waveform images: The website displays the message: "Waveform image is not found". It is surmised that this situation is caused by continuous troubles exceeding 1 day or 1 hour. The reasons are not shown. Update of the information is daily with 2 days delay.

The two sources do not coincide, while overlap partially. At the captioned earthquake, both showed increase before the main shock. Thus analysis on the latter, by counting number of stations with missing images from June 1, 2010 to May 15, 2011, is carried out.

3. Results

As shown in Fig. 1, for 6 months from June 15, 2010 to December 14, 2010, the average number of the stations with missing images = 0.33 with the standard deviation (Sigma) = 1.11 (Notes: For total loss, 10 (1/7 of total) is used for the calculation). It was stable with the daily missing number of less than 1.

There was the first increase from December 22, 2010 to January 18, 2011, and reached the number of 4. Then there was the 2nd increase from February 16, 2011 to March 2, 2011. Especially from February 19 to March 2, it again became 4 stations (Sapporo (Code:HSS), Yamagata (YIG, Iwate pref.), Kesennuma (KSN) and Shiramine (SRN)) as shown in Fig. 2. At the main shock, the number was 2, which was still more than usual. It returned to 0 on May 2. Missing of 4 was 3.3 Sigma, meaning that the state was far from stable. Yamagata and Kesennuma stations are located close to the epicenter, and the distance between them is short. The period of 2nd increase overlapped seismically active period of February 13 to March 2 when M5 earthquakes occurred continuously in the epicentral region.

The data acquisition trouble log shows that "electric power supply trouble" and "data logger restart recording" are the causes of troubles for long and short respectively.

For the Sapporo station, reason of the trouble was "observatory set up", thus the cause might be other than ground motion. In such a case, the missing = 3, meaning 2.4 Sigma. Still it was in a rare state.

4. Discussions

It is assumed that increases of the missing waveform images preceding the big earthquake was because that the F-net could not withstand possible long-period intense vibrations of the earth's surface. For the seismometers, they could be big motions like landslides.

"Electric power supply trouble" might be a good index showing excessive vibration. And rapid increase of "Data logger restart recording" might show the system becoming unstable.

Such phenomena are not observed for the Hi-net seismograph network, probably because of its characteristic (Natural frequency = 1 second).

The author realizes that further studies to increase number of evidences are necessary.

Acknowledgement

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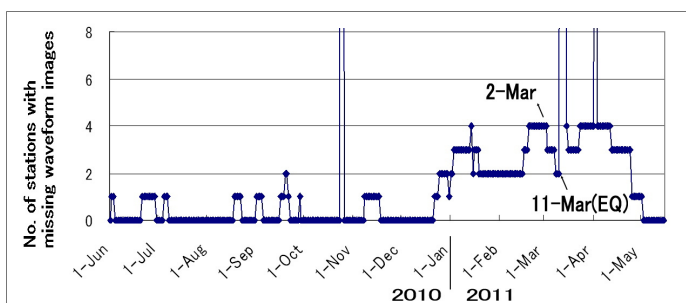
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References

Yoshiki Sue, 2010, Long-period vibration recorded by waveform images of the F-net Broadband Seismograph Network, Part 1, SSJ Fall meeting, D31-12. (In Japanese)

Keywords: F-net, broadband, seismograph network, long period, waveform



HOKKAIDO region			
HIL	DSS	DHG	KMJ
KIP	KSR	NKG	NMR
NOP	SHB	URH	
TOHOKU region			
GLM	HFO	IYG	KSK
KSJ	MMA	TMR	IYS
KANTO region			
BSJ	BSI	HJO	KZS
ONS	OSW	TSK	VMZ
CHUBU region			
ADM	FUJ	JIC	KNM
BYJ	KIK	MIA	SBT
SGJ	SRJ	TIO	WJM
KIBU region			
RSJ	KK	NMT	NOJ
ISA	WTR	YAS	YCA
CHUGOKU region			
MFJ	NSJ	SAG	DSJ
SHIKOKU region			
ISJ	DAW	HOJ	ISA
KIUSU region			
AMM	EJK	OKJ	BNJ
KHJ	BGM	KYJ	SFR
SIR	SJM	FAS	TKJ
TKO	TMC	YNG	SMM

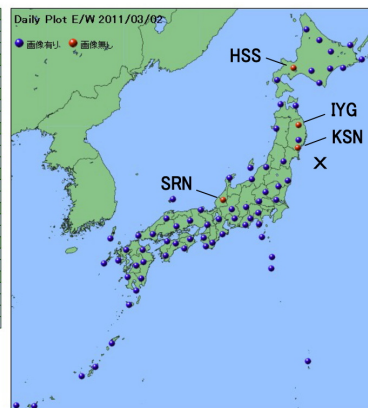


Fig. 1. No. of stations with missing waveform images from June 1, 2010 to May 15, 2011.

Fig. 2. Arrangement of stations with missing waveform images on March 2, 2011 (Source: NIED).